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Study of quantum spin models on two-dimensional square lattice using entanglement renormalization method

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Entanglement renormalization (MERA) was proposed by Videl and Evenbly [1] as a promising method to study D-dimension quantum spin models. The key of this method is to use local unitary transformations to remove short range entanglements, prevent them from accumulation, so that coarse-graining can be applied afterward to obtain a better description of the quantum spin states with lower computational effort.

We apply the MERA method to study the J1-J2 frustrated spin model on 2D square lattice. We used several different MERA tensor networks, some proposed by Evenbly and Vidal, some developped by ourselves. The results shows that the structure of the tensor network has significant impact on the ground state we obtain from the MERA calculation. The ground state energy we obtained are comparable with other method. We observe a Valence-bond-solid phase in the intermediate J1-J2 region. We also use these MERA tensor networks, designed for square lattice, to study anisotropic triangular Heisenberg model.

References

[1] G. Evenbly and G. Vidal, Phys. Rev. Lett. **102** 180406 (2006).